as in making photographic prints. After fixing and washing the records appear as brilliant, brownish-black lines on a white ground. The curves are of exceptional fineness.

At the last international ascension on April 5, 1905, from the Central Institution for Meteorology and Geodynamics of Austria, located on the Hohewarte, near Vienna, a test was made simultaneously of the above-described new fixing method and a new device constructed by me for automatically lifting the recording pen after the landing.

The principle upon which my automatic engaging and disengaging arrangement is based is briefly as follows: As long as the protecting case in which the registering apparatus is installed rests upon the ground, the marking pens are lifted from the cylinder, but when the basket is lifted from the ground by the balloon, its weight stretches a spiral spring. This turns the disengaging lever upon its axis and permits the recording pens to touch the drum in a writing position. So long as the apparatus remains floating in the atmosphere, that is to say, throughout the whole duration of the ascension, the spiral spring is held in this strained condition. The recording pens rest, therefore, upon the drum and trace the record. But at the moment when on landing the basket again rests upon the ground, the pull exerted by the supporting balloon is withdrawn from the line joining the balloon and basket, thereupon the force of the spiral spring again comes into action and turns the disengaging lever back again to the position of rest, whereby the writing pens are lifted from the drum and remain lifted. Heretofore a scratching and partial obliteration of the original curves was inevitable because the pens continued writing for many hours after landing, and through the unavoidable movement of the pen levers backward and forward in consequence of agitation during transportation. The exact evaluation of the curves is made extremely difficult on this account. By using my automatic device the scratching of the original trace, or the obliteration of the zero line, is practically impossible, since the writing pens rest on the recording drum only while the apparatus floats in the air.

In addition to the advantages thus mentioned which the automatic device possesses over the usual method heretofore followed, the manipulation of the registration apparatus before the ascension is essentially reduced and simplified by its use as we shall briefly set forth. Heretofore it was necessary immediately before the ascension to adjust the time lines and arrange the zero line of the pen levers. Not until then could the apparatus be placed in the basket and secured therein. This whole procedure requires about fifteen to twenty minutes of time, and, especially in winter or rainy weather, is often decidedly unpleasant, as naturally most of the work must be done in the open air. A further objecton to the old method is that the pens remain in a writing position during the whole time that elapses between the preparation of the apparatus and the liberation of the balloon, and, by the unavoidable jarring of the apparatus, the soot coating of the recording drum is badly scratched. All of these disadvantages are wholly avoided by employing the automatic engaging and disengaging device. The meteorograph can be fully installed and secured in the basket the day before, or still earlier, and nothing remains to be done before the ascension but to wind the clock-work by means of a special key. Since the writing pens begin to write only at the moment the basket swings free in the air, therefore, the beginning of the registration and the zero line for the reduction of the curves start off simultaneously.

The curves obtained in the international balloon ascents during April and May, 1905, as produced by the new photographic method and with the automatic pen lifter, were laid before the academy.

There is undoubtedly much merit in both these developments by Mr. Nimführ, and the writer was at once led to employ the new photographic method in a different way from that mentioned by Doctor Pernter, namely: To make seismic records by it from instruments adapted to mechanical registration. Even ordinary blueprint (ferro-prussiate) paper is found to produce very clear records by this method, in fact the only objection which might be urged against the use of the large-sized record sheets required with the seismograph and such instruments is the item of cost for the paper and the trouble in toning and fixing the photographic prints.

There is a kind of record sheet still different from any of these that is especially appropriate for the kite and balloon meteorographs and where ink records can not be used for one reason or another. The method however requires the use of glass or celluloid or metal foil sheets. Instead of coating the sheet with soot a uniform coating of black printer's ink is applied by means of the usual hand roller. With a few simple facilities for the purpose an exceptionally fine writing surface can be produced. The record is traced on this surface in the usual way by means of a fine, smooth-pointed stylus. After 24 hours, more or less, according to the quality of ink used and the amount applied, the sheet and its record will dry hard and firm. If desired, the drying of the record may be hastened by a gentle heat carefully applied. The writer has not had an opportunity to actually test this manner of securing records, but it does not appear to present any serious difficulties; ink coatings on glass have been tried in connection with certain engraving processes with very promising results.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY AFTER THE ERUPTION OF MOUNT PELÉE, MAY 8, 1902.

By Prof. ARTHUR W. WRIGHT. Dated New Haven, Conn., June 22, 1905.

During the recent visit of Prof. Cleveland Abbe to the Sloane Physical Laboratory certain observations of atmospheric electricity, which had been made here just after the great eruption of Mount Pelée, were referred to in a conversation with him by the writer, and at his request the following account is communicated:

This laboratory was one of the stations established in 1884, under the direction of the Chief Signal Officer, for the study of atmospheric electricity, and systematic observations were carried on for nearly two years by Mr. O. L. Fassig, the observer detailed for this work. After the suspension of operations on the part of the Government observer, the work was continued in the laboratory, and since then the observation of atmospheric electricity has been one of the regular exercises of the physical laboratory, and, with few exceptions, each student makes the observation in the ordinary course of his laboratory work. This part of the electrical work is usually taken up during the months of April, May, and June. In consequence of this arrangement it resulted that in the laboratory exercises of May 8 and May 9, 1902, observations of the electrical condition of the atmosphere were made by students assigned to the work, and the records preserved in their note books, with curves showing the course of the changes in the atmospheric potential during the period of the exercise.

The curves thus obtained are reproduced in figs. 1 and 2. The actual time of the observations was between the hours of 10 and 11 a. m., the measurements beginning at the former hour, approximately, and continuing at intervals of three minutes for the time indicated in the figures. Other work in the measurement of potential, with the quadrant electrometer, ordinarily precedes the observation of atmospheric potential, so that the time given to the latter is limited somewhat and varies from one occasion to another.

Fig. 1 represents the observations of May 8, 1902, as made by Mr. Frank J. Sladen and Mr. Norman C. Thorne, of the class of 1902. The curve does not show very marked deviation from the normal or the average of those generally obtained here, except that the changes are somewhat more rapid and abrupt than is usual.

The curve reproduced in fig. 2 was drawn by Mr. W. W. Duncan, of the same class, from his observations made on the morning of May 9, 1902, the day following the eruption of Mount Pelée. It is remarkable in several particulars, but especially for the fact that it indicates a considerable negative potential for the greater part of the period of observation. This is more remarkable, as on that day the weather was fine and clear. Mr. Duncan's note upon this is to the effect that it "was a bright, clear day, with no signs at all of thunderstorms or electrical disturbances." In this respect the observation is unique among those made here during the past twenty years, as during all this time the atmosphere has uniformly shown a positive charge in fair weather, except perhaps a mere momentary dipping below the zero line in a few instances. Strong and sustained negative potential has never been observed here, except on occasions of heavy rain or snowfall. The result obtained on May 9 was so striking and unusual that several observations were made later in the day. The potential remained strongly negative during most of the afternoon, though apparently diminishing slowly. The next day it was found to be positive again and did not depart from the normal conditions. Another peculiarity of the record of May 9 is the vacillating character of the charge observed, the larger excursions of the curve having superposed upon them a number of small and rather rapid fluctuations, whereas, in general, the variation of potential occurs gradually and rather slowly.

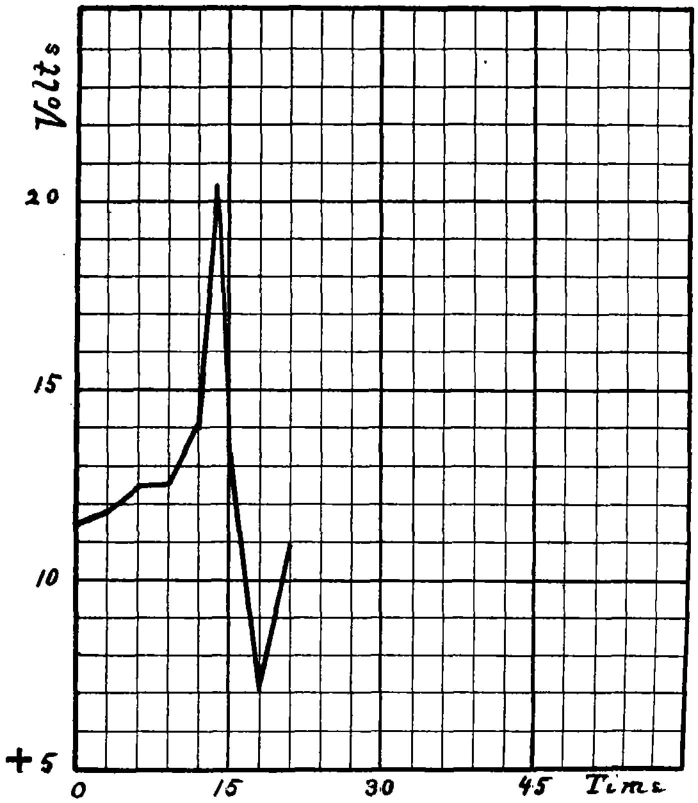

FIG. 1.—Observations of May 8, 1902.

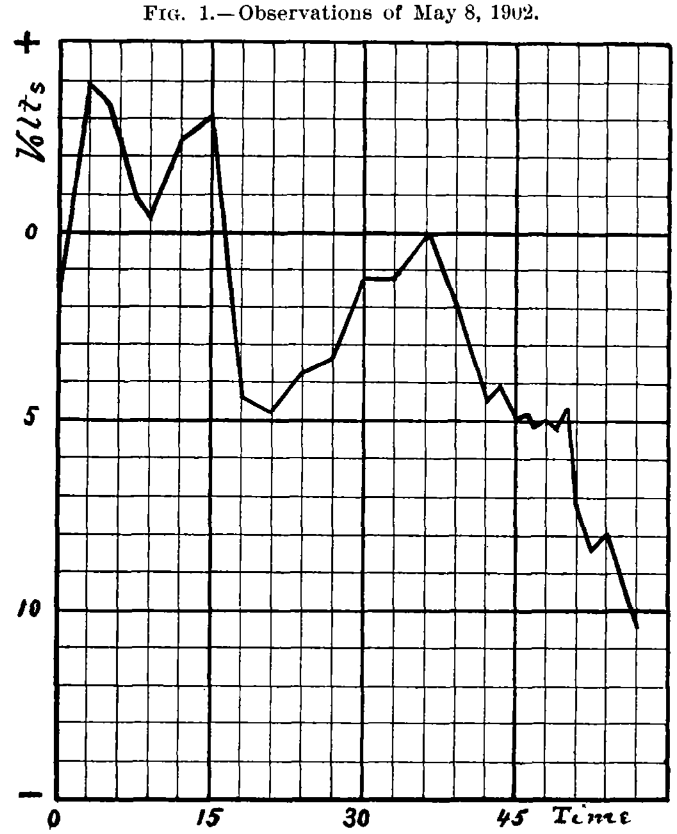

FIG. 2.—Observations of May 9, 1902.

These results appear to indicate an abnormal electrical condition of the atmosphere, and the influence of some energetic disturbing agency. It seems not at all improbable that the immense volumes of gases and other eruptive products ejected from the crater of the volcano, and which were manifestly the seat of intense electrical charges, may have made their influence felt, gradually and progressively, at great distances from their point of origin, and so have produced a widespread disturbance of the electrical condition of the atmosphere. This would naturally accord with the absence of any immediate and radical departure from the normal in the observation of May 8, made within about two hours after the great eruption, the minor peculiarities observed being such as might be due simply to inductive effects at a distance.

IMPROVED METHODS FOR FINDING ALTITUDE AND AZIMUTH, GEOGRAPHICAL POSITION, AND THE VARIATION OF THE COMPASS.

According to St. Hilaire's method, having found the altitude and azimuth of a celestial body for an estimated geographical position of the ship, a navigator can at once obtain a Sumner line or locus of position. He simply draws a line through the estimated position on the chart in the direction of the azimuth or true bearing of the body and lays off along this line of bearing an intercept from the estimated position equal to the difference between the altitude as deduced from instrumental measurement and the altitude that the observed body would have if the observer stood in the estimated geographical position. This intercept is drawn toward the direction of the observed body or away from it, according as the measured altitude is higher or lower than the altitude due to the estimated position. A straight line drawn at right-angles to the line of bearing, through the point thus obtained, will be the Sumner line required.[1]

This method rids the observer at once of the trammeling process of selecting a celestial body on or near the prime vertical for the computation of the longitude, and a celestial body on or near the meridian for the computation of the latitude, because it has the indisputable superiority of giving a Sumner line from the observation of a celestial body in any azimuth. But the drawing of this line requires the finding of the altitude and the corresponding azimuth at the estimated geographical position of the observer, and the determination of these elements by the ordinary formulas necessitates as much computation as navigators and geographers have been accustomed to perform in the calculation of time and longitude.

Purposing further to recommend to navigators the advantages of the method of St. Hilaire, Professor Souillagouët, of the French Navy, in the year 1900, published extensive tables, intended to shorten the work of calculating the altitude and azimuth, in a volume entitled "Tables du point auxiliaire pour trouver rapidement la hauteur et l'azimut estimés."

ALTITUDES.

The table for finding the altitudes is based upon the following conditions. In fig. 1, let P be the pole of the celestial sphere, Z the zenith of the observer, and A the position of the observed celestial body. Then, drawing a spherical perpen-

[1] The Sumner line is so called from its inventor, Capt. Thomas H. Sumner, an American shipmaster, who seems to have accidentally discovered its application to ocean navigation in 1837. If when at sea the navigator measures the apparent altitude of the sun, or any other celestial body whose right ascension, hour angle, and declination are known, he then knows that he must be somewhere on a small circle on the globe whose center is vertically beneath the sun or star. That portion of this circle passing through his assumed approximate position on the globe is called a Sumner line. If he can observe another celestial body, or if he can wait a while and observe the same body in a different position, he can draw a second Sumner line, and the intersection of the two will give him the location of his vessel with all the accuracy that is practicable. A full description of Sumner's method is given in works on navigation, and especially in the American Practical Navigator, Chapter XV, as published by the U. S. Hydrographic Office.—ED.